Original paper

THE EFFECT OF FEEDING PROGRAMMES ON BROILER PERFORMANCE AND PRODUCTION EFFICIENCY

Tolimir N.[*1], *Milošević N.*[2], *Ceranić C.*[3], *Škrbić Z.*[4], *Maslovarić M.*[1]

[1] Institute for Science Application in Agriculture, Serbia
[2] University of Novi Sad, Faculty of Agriculture, Serbia
[3] University of Belgrade, Faculty of Agriculture, Serbia
[4] Institute for Animal Husbandry, Belgrade, Serbia
[*] Corresponding author: ntolimir@ipn.co.rs

Abstract

The goal of the paper was to investigate the effect of feeding programmes with different protein levels on broiler performance and production efficiency. The research was conducted on 600 chicks of Cobb-500 and Ross-308 provenience, previously divided into four groups (by feeding treatments).

The groups (treatments) differed in the type of mixture given in the starter period. The feeding programmes were, as follows: T1 (control group) – 23% protein mixture (Day 1 to Day 21); T2 - 23% protein mixture (Day 1 to Day 14), and 20% protein mixture (Day 14 to Day 21); T3 – 23% protein mixture (Day 1 to Day 7), and 20% protein mixture (Day 7 to Day 21); T4 - 20% protein mixture (Day 1 to Day 21). The chicks were given 20% protein mixture from Day 21 to Day 35, and 18% protein mixture from Day 35 to Day 42. A standard technology for chicken fattening was carried out. Production efficiency was determined by observing the ratio of the total cost and total revenue, i.e. profit per chick. From the value of the European Production Efficiency Factor (EPEF), a summary indicator of production results, the authors came to a conclusion that T1 (control) group of the Cobb-500 and Ross-308 chicks had achieved higher EPEF than the experimental groups, whereby the values of T2 group were similar to the values of T1. The highest profit per chick was found for T1 group of Cobb-500 chicks and for T2 group of Ross-308 chicks. The research showed that a drastic protein reduction in the starter period had resulted in negative tendencies in the chicks of the both genotypes. From the aspect of development of more profitable feeding programmes, further research should therefore focus on T2 feeding programme.

Key words: *broiler, genotype, production efficiency, production performance*

Introduction

In broiler production, a proper diet is one of the most important preconditions for expressing the genetic potential of modern hybrids. Broiler diets comprise feeding programmes that follow recommendations given in NRC Standards (National Research Council, 1994),

programmes of breeding centres – producers of line hybrids, and programmes aimed to satisfy some specific market requirements (e.g. the production of meat of special quality) as well as environmental and other requirements for modern broiler production.
A diet is also one of the key factors affecting broiler production efficiency, since feed costs make about 70% of the total cost of production (Marcu et al., 2013). The cost of the protein component in broiler mixtures generates the largest share of feed costs, together with energy sources (Moosavi et al., 2011). Over the last decade, one can see the tendency of protein reduction in broiler mixtures, due to economic and environmental requirements. Proteins have an important role not only in enabling the carrying out of the basic life functions but also in providing conditions for expressing the genetic potential, in terms of broiler productivity. Therefore, nutritionists try to develop such feeding programs that will optimally meet broiler requirements and requirements for production efficiency. There are also some aggravating circumstances – protein requirements can fluctuate a lot, depending on the genotype, sex, age, production programme, etc., and one should have in mind that the efficiency of protein utilisation can also differ depending on the protein source and levels of other nutrients in a diet (Jokić et al., 2004).
To increase production efficiency, some feeding programmes are designed to maximise profits instead of maximising production performance. The research conducted by Eits (2004) was aimed to develop a model to make choosing of optimal feeding strategies much easier, in terms of achieving preferable performances with minimal costs.

In order to determine an optimal amount of time for giving basic mixtures, and considering broiler performance and production efficiency, the subject-matter of the research of numerous authors was phase feeding programmes, i.e. programmes based on different frequencies of change of feeding mixtures – starters, growers and finishers (Watkins et al., 1993; Saleh et al., 1996; Pope and Emmert, 2001; Roush et al., 2004). The aforementioned authors mostly indicated a necessity for questioning traditional feeding programmes and duration of each feeding phase. They also pointed out some genetic improvements in broilers, a shorter time for gaining body weight, as well as a growing need for the economic optimisation of broiler production. The economic effect of changing starter mixtures with growers is based on the difference in costs of starters and growers. According to Warren and Emmert (2000), the duration of a feeding phase significantly affects fattening efficiency, i.e. phase feeding programmes can reduce feed costs, without affecting weight gain and body yield.

The goal of the paper was to investigate the effect of feeding programmes comprising different protein levels, i.e. different frequencies of change of starter and grower mixtures on performances of different genotype broilers and their production efficiency.

Materials and methods

The experiment comprised 1.200 chicks, i.e. 600 chicks of Cobb-500 and 600 chicks of Ross-308 provenience. Within each genotype, four groups (treatments) were formed, with two repetitions per treatment. The object was divided in 16 pens (75 chicks each). The treatments and repetitions were assigned by a randomised block design. Each treatment comprised 150 chicks, which makes 600 chicks per provenience investigated. Feeding differed only in the starter period (from Day 1 to Day 21), according to the following programme:

- T1 (control group) - 23% protein mixture (starter) from Day 1 to Day 21;

- T2 - 23% protein mixture (starter) from Day 1 to Day 14, and 20% protein mixture (grower) from Day 14 to Day 21;
- T3 - 23% protein mixture (starter) from Day 1 to Day 7, and 20% protein mixture (grower) from Day 7 to Day 21;
- T4 - 20% protein mixture (grower) from Day 1 to Day 21.

From Day 21 to Day 42, all the chicks were fed in the same way. They were given 20% protein mixture (grower) from Day 21 to Day 35, and then 18% protein mixture (finisher) to Day 42. Feeding was *ad libitum*. A standard fattening technology was carried out, following all technological norms of intensive fattening.

All the chicks were marked, after which control weighing on a precision balance was conducted on the Day 1 and then on a weekly basis. Daily gain was calculated on the basis of the data on body weight. Data on the used feed and achieved gain were used to calculate feed intake and conversion.

The obtained production parameters were then used to calculate the European Production Efficiency Factor (EPEF = liveability (%) * body weight (kg) / number of days of fattening * feed conversion) * 100) and the European Broiler Index (EBI = liveability (%) * average daily gain (g) / feed conversion *10).

Production efficiency was determined after taking into account the value of production and the total cost, i.e. profit per chick. A profit index per chick was calculated for each feeding programme, whereas the obtained profit per chicken for the control group was used as a basis for calculating the profit index per chicken for experimental feeding programmes.

The data were statistically processed using the computer programme Statistica (version 5) (Stat.Soft.Inc, 2006). Individual differences in means were compared with the LSD test.

Results and discussion

Having analysed the data given in Table 1, the authors determined that at the end of the starter and the fattening period (after 42 days) the Cobb-500 chicks from the group T1 had achieved the largest body weight. Statistically, the value of their body weight was significantly higher than the value of the body weight in the groups in which feed restriction had started in the first (T4) and second week (T3). No statistical significance was detected between T1 and the group in which protein reduction had started in the third week (T2). As for the chicks of Ross-308 provenience, after comparing T1 with the experimental groups and comparing the experimental groups among themselves, the results showed T4 group (largest protein reduction) was the only one with significantly smaller body weight in the aforementioned periods. This result showed certain differences among hybrids, i.e. that the Ross-308 chicks were more tolerant to protein reduction and to a shorter period of feeding with the starter mixture. Different reactions of hybrids were also detected by Madrigal et al. (1994) when investigating the effect of feeding programmes. Smith and Pesti (1998) also investigated the effect of different feeding programmes on two proveniences and determined that the hybrid and the level of protein in mixtures had affected production performances - body weight and feed intake, which is in line with the results of this research. Saki et al. (2010), however, studied three feeding programmes applied on two genotypes in their starter period and found no statistically significant interactions between the hybrids and the feeding programmes.

Table 1. *Broiler production performances*

Traits	Measures of variation	Broiler production performances							
		Cobb-500				Ross-308			
		T1	T2	T3	T4	T1	T2	T3	T4
Day 1 to Day 21									
Body weight	$\bar{x}$	642[a]	621[a]	614[b]	530[c]	642[a]	638[a]	623[a]	554[b]
	Sd	116.54	87.12	85.87	92.08	93.28	104.57	100.71	94.54
Average daily gain (g)	$\bar{x}$	28.81[a]	27.80[a]	27.48[a]	23.48[b]	28.78[a]	28.55[a]	27.90[a]	24.63[b]
	Sd	5.51	4.12	4.05	4.38	4.41	7.26	4.79	4.47
Average feed intake (g)		50.229	49.029	55.465	56.357	50.382	50.402	56.820	51.232
Day 1 to Day 42									
Body weight (g)	$\bar{x}$	2279[a]	2216[a]	2203[b]	2048[c]	2177[a]	2166[a]	2136[a]	1963[b]
	Sd	261.96	244.05	210.31	234.56	266.24	264.00	287.00	247.72
Feed conversion		1.871	1.918	1.994	2.058	1.914	1.927	2.022	2.126
Mortality, (%)		2.67	2.33	2.50	2.17	2.50	2.17	2.33	2.50
EPEF		282.27	268.68	256.47	231.79	264.04	261.82	245.66	214.35
EBI		277.63	264.04	252.11	227.65	257.55	257.24	241.32	202.2

a-b - values with different superscript letters in the same line for hybrids are statistically significantly different ($P < 0.05$)

In the chicks of Cobb-500 and Ross-308 provenience, the smallest, insignificant difference in finished body weight was found by comparing T1 with T2 group, which consumed the starter mixture for two weeks. This result raises a question whether the chicks in the starter period need starter mixtures for longer than 14 days. The obtained results are in line with the research of Saleh et al. (1997), who estimated the periods of giving starter, grower and finisher mixtures to fattening chicks in the fattening period of 42 days. These authors pointed out the importance of targeting finished body weight when creating feeding programmes, and they gave recommendations for duration of certain feeding phases, considering the finished body weight of 1 kg, 2 kg or 3 kg (Saleh et al., 1996, 1997a and 1997b). For the both investigated genotypes, after comparing T1 with the experimental groups, significant and also the largest difference in finished body weight was found between T1 and T4 group, observed by periods and in the whole experiment. A lag in weight gain, found in T4 group during the starter period but also in the second fattening phase, was a result of a drastic protein reduction, since these chicks were fed with the grower mixture from the first day. The obtained results are in line with the other researches, where chicks subjected to drastic protein reductions in their early period lagged behind in weight gain, not being able to compensate it later (Watkins et al., 1993).

The analysis showed best feed conversion in T1 group and poorest in the experimental groups with the highest protein reduction (T3 and T4). The obtained results can be somewhat compared with the one of Jianlin et al. (2004), who investigated eight feeding programmes in the starter period of broilers, where the control group was given feed with 22.48% crude protein, and each following experimental group was given feed with reduced protein levels,

the lowest of which was 16.61%. Body weight and feed conversion was smaller than in the control group, and the more reduced protein levels were, the smaller was the body mass and feed conversion. Dozier et al. (2006) also investigated the effect of phase programmes with different protein levels, and found that chicks fed with mixtures with higher protein levels and nutrients had achieved larger body weight and better feed conversion.

The broilers of Cobb-500 and Ross-308 provenience were of satisfying liveability, which implies that the feeding programmes did not affect this trait. The obtained results are in line with the results of Watkins et al. (1993), in which different time distribution of mixtures did not affect broiler mortality. However, Salmon et al. (1983), when investigated the effect of different feeding programmes on liveability, found high protein levels in starter mixtures that resulted in increased total mortality.

From the obtained value of EPEF, a summary indicator of production results, the authors came to a conclusion that T1 (control) group of the Cobb-500 and Ross-308 chicks had achieved higher EPEF than the experimental groups, whereby the values of T2 group were similar to the values of T1. The results of EBI showed that the highest profit per chick of Cobb-500 provenience had been identified for T1 group, with the smallest difference between T1 and T2 programmes. EBI for T1 and T2 group of the chicks of Ross-308 provenience were completely uniform. The obtained results for EPEF and EBI for the chicks of the both provenience implies that further research should focus on T2 feeding programme. Differences in EPEF and EBI were also found by Marcu et al. (2013), when investigated feeding programmes with different protein and energy levels.

The production efficiency of the feeding programmes, determined after comparing the value of production and the total cost, i.e. profit index per chick, is shown in Table 2.

Table 2. *Broiler production efficiency, depending on the feeding programme*

	Profit index per chick, depending on feeding programmes (%)							
	Cobb-500				Ross-308			
Parameter			Feeding programmes					
	T1	T2	T3	T4	T1	T2	T3	T4
Index	100	93.64	80.98	38.73	100	116.31	75.62	15.58

The highest profit index per chick was found in T1 group of the Cobb-500 chicks and T2 group of the Ross-308 chicks. The feeding programmes with drastic protein reduction (T3 and T4) achieved the lowest profit indices, which can be related to the smallest finished body weight and poorest feed conversion that resulted in the lowest profits for these groups. The results are in line with the research of Moosavi et al. (2011), in which feed costs per kg were different. They were lower for mixtures with lower protein levels, yet production costs were then higher due to poorer feed conversion, considering the chicks were fed with mixtures with lower protein and energy levels. Differences in profit indices of different feeding programmes were also detected by Petričević et al. (2012).

Conclusion

Based on the obtained results, it was determined that the applied feeding programmes with different protein levels (different frequencies of change of starter, grower and finisher mixtures) for Cobb-500 and Ross-308 chicks had affected the production performance and efficiency. When observing the production results for the whole experiment, in the both provenience, T1 (control) group achieved the highest European Production Efficiency Factor (EPEF) compared to the experimental groups (T2, T3 and T4). The applied feeding programmes with a drastic protein reduction in the starter period (T3 and T4) resulted in negative tendencies from the aspect of production results and efficiency. In the both provenience, the experimental group T2 achieved similar values of EPEF to T1. Moreover, when it comes to the Ross-308 chicks, T2 group also achieved the highest profit index per chick. From the aspect of the development of more profitable feeding programmes, the focus of further research on optimising the periods of giving starter, grower and finisher mixtures should be put on T2 programme.

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